DOCUMENT RESUME

ED 380 071 IR 016 992

AUTHOR Ruberg, Laurie F.; Moore, D. Mike
TITLE Visualizing Qualitative Data in a Study of Student Interactions within a Computer Mediated Environment.
PUB DATE [95]
NOTE 9p.; In: Imagery and Visual Literacy: Selected Readings from the Annual Conference of the International Visual Literacy Association (26th, Tempe, Arizona, October 12-16, 1994); see IR 016 977.
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS College Students; Computer Graphics; Computer Interfaces; *Computer Mediated Communication; Computer Networks; Content Analysis; *Data Analysis; *Ethnography; Higher Education; *Student Participation; Surveys; Visual Arts
IDENTIFIERS *Graphical User Interfaces; *Graphic Organizers

ABSTRACT

This paper discusses the visual organizers and graphic interfaces used to manage and report the findings from a 10-month ethnographic study of student participation and interaction in computer mediated communication (CMC) activities within the classrooms of both a freshman writing class and a plant science lab. The study focuses on social psychological issues, expressed in discourse created from computer-based interactions, from student survey self-reports, or from the observation and reporting process. It is contended that data analysis is problematic, since generation of data is affected by what the ethnographer can treat as writable, readable, visible, and interpretable, and analysis requires various visual organizers and graphic descriptions, the following of which are used in this study: research questions; tables; quantitative coding of raw data; charts/tables; hypercard stacks; figures; digital photographs; and excerpts from computer-based discussions. Graphical interfaces for the following components of the study are discussed: interviews/field observation; surveys; videotape material; and electronic discussions. Discussion concentrates on graphical interfaces for electronic discussions, and includes issues such as coding data according to content description and affective quality, quantitative measure of network connections, and message act analysis. Data is illustrated in 6 figures. (Contains nine references.) (MAS)

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Visualizing Qualitative Data in a Study of Student Interactions within a Computer Mediated Environment

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Laurie F. Ruberg
D. Mike Moore

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Description of Study

As electronic technology is increasingly used as medium for teaching and learning, the social context of the classroom is undergoing changes as well (Johnson-Lenz & Johnson-Lenz, 1991; Solomon, G., 1991; Wiburg, 1994). The research study described in this presentation examined how an application of network technology can affect the social context of the classroom. This paper discusses the visual organizers and graphic interfaces used to manage and report the findings from a 10-month ethnographic study of student participation and interaction in computer mediated communication (CMC) activities within the classroom. The dual settings for this study included two university classes taught at Virginia Tech: a freshman writing class and a plant science lab.

The study described in this paper focused on social psychological issues which were primarily expressed in words gathered from the discourses created from computer-based interactions, or from self-reports by students in their surveys, or from words used in the observation and reporting process. "Such data are not usually immediately accessible for analysis, but require some processing" (Miles & Huberman, 1994, p. 9). The processing of this data is itself problematic for as Atkinson (as cited in Miles & Huberman, 1994, p. 9) points out, "What may be generated as 'data' is affected by what the ethnographer can treat as 'writable' and 'readable.'" We further suggest that data is also affected by what can be treated as visible and interpretable and subsequently described in words. This report will demonstrate how different kinds of visual organizers were used and how these visuals led to meaningful comparisons and interpretations of the data which might otherwise not have been recognized.

The kind of visual organizers and graphic descriptions of data used included:

- Research Questions - semantically framed the observations and archives of raw data
- Tables - summarized survey data and narrative self-reports by participants
- Quantitative coding of raw data - enabled statistical comparisons of transcript data
- Charts/Tables - summarized quantitative data
- HyperCard stacks - categorized raw data into semantic themes
- Figures such as the message flow analysis - provided a diagram of the nature and sequence of student participation in CMC discussions
- Digital photographs - documented classroom interactions in the plant science lab
- Excerpts from the computer-based discussions - provided illustrations of student attitudes and behavior.

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All of these types of visual representations of data and analysis are discussed from within the context of the CMC research study described above.

Main Issues in Focus of Study

The main focus of this study was to describe the characteristics of student interactions within a computer-mediated social environment. Specific questions that were answered in this study address the following issues:

- How do students interact on-line?
- How do they influence and regulate one another in this environment?
- Is the frequency of participation in the computer-mediated discourse equally distributed, or do some students dominate the discussion more than others?
- What relationship does frequency of participation have on influencing the outcome of the discussion?

Research Data

This is a qualitative study which looks at the student social behavior in a computer-mediated environment and as such it includes a variety of raw data not typically gathered in experimental or other quantitative research. The data gathered in this ethnographic study includes field notes from classroom observation

The participant observation was situated in a two freshman composition classes--one in the Fall of 1993 and another in the Spring 1994--and a plant science lab which was offered in the Spring semester of 1994. An additional 25 to 30 hours was spent in discussions with the freshman composition instructor or in telephone or electronic conversations with him regarding the design and implementation of the on-line exercise for the upcoming class, and an additional 780 hours was spent working as a graduate assistant working with the plant science lab design team in the development of instructional material. Field notes gathered from observation over a six-month period consisted of hand-written and/or electronic notes consisting of narrative descriptions of events observed. Graphic organizers for the field notes from these observation activities included a time line, the classroom diagrams and videotape material in the Plant Science Lab. In addition, the *HyperQual* HyperCard program provided an electronic means to summarize, categorize, stack, and sort worthwhile material identified from the hand-written notes.

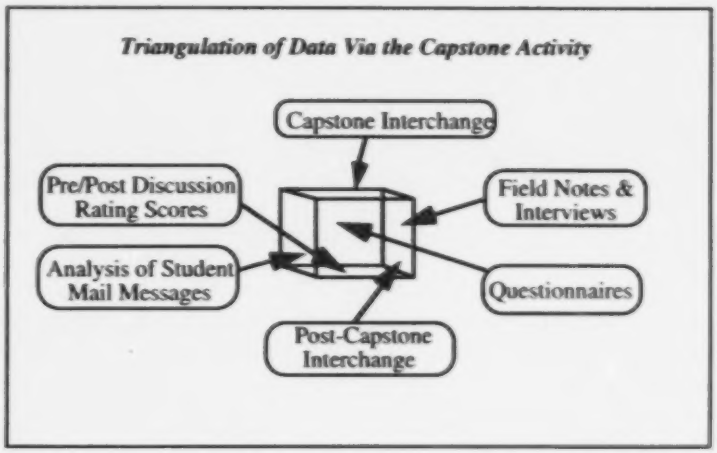

Figure 1. Description of Capstone Data

This study also included a critical observation event in each class referred to as the *capstone activity* which provided some quantifiable data as well as electronic text archives and observation notes. Figure 1 provides a graphic summary of the multiple data sources gathered as part of the capstone activity. The data obtained from the capstone tasks included quantitative as well as qualitative information which was compared within and across classes. A variety of charts and graphs and tables comparing individual

and group ratings were used to illustrate differences between students which were also noted in narrative form in the observation notes.

Both classes included initial and exit questionnaires which students completed independently, providing their answers on paper. Comparisons and analyses of student responses to these questions are presented in tables and graphs to illustrate particular areas where individual student responses differ greatly from the class mean as well as where the two classes were similar and different.

Graphical Description of Settings

A graphic map depicting the layout of the classroom for both settings was used as a tool to make notations regarding where students sat, what activities took place where, and how the physical setting related to on-line and face-to-face interactions.

Freshman Writing: The freshman writing class had 22 students and met (once a week) every other class period in a computer integrated classroom (CIC) set up by the English Department. Unlike the traditional classroom in which the teacher is the focal point of the room, the CIC is designed so that the student's individual computer screen is usually the focal point during this class. The alternate setting for this class was in a traditional classroom setting with rows of chairs all facing the teacher positioned in front of a blackboard defining the front of the room.

Plant Science Lab: A total of thirteen students completed this course which included a variety of interactions with technology. Some students shared computer workstations which were set up on top of existing lab tables. The table where most of the slicing of specimens and preparation of microscopic slides was done was located at the far end of the room. Students found that getting up and moving around the lab and doing different kinds of activities was important to break up the three-hour lab period.

Graphical Interface for Interviews/Field Observation

The field observation included notes of events that occurred during both of the classes being studied. These observations are most meaningful in the context of the date, time, and context in which they occurred, and so it is important to link data from the field notes to the time line for the project and to the underlying themes which were the focus of this study. A chronological time flow chart shown in field notes coded by date were linked to the time flow for the project. This is an important process because events occurring at an early point in the project will be interpreted with somewhat different expectations than those occurring near the end of the project.

Linking data to the underlying themes and issues being studied was more difficult. The HyperQual HyperCard program was a useful resource to make this process go more efficiently. This program is designed to electronically simulate manual methods of organizing field notes and survey data. However, it is easier to move, sort, copy, and paste narrative data that is electronic than physical material. Figure 2 shows what these cards looked like. Another benefit to using this program is that stacks can be searched and data can be regrouped according to semantic themes. These stacks can then be selectively or as a group moved out of HyperCard into a compatible word processing program.

Graphical Interface for Surveys

Students completed several kinds of printed questionnaires for this study. An initial list of questions was used to get a profile of each student's previous experience with computers and with participating in collaborative tasks. Many of these questions were open-ended and the kind of tables used were designed to move narrative responses from individual students to a table which could show how this response compared with others.

Graphical Interface for Videotape Material

The plant science lab class contained a lot of visual material in the computer-based instruction and in the hands-on manipulations of live plant specimens. Obtaining visual data to document student interactions with this visual material was important in this setting and much less important in the freshman writing setting. All the students in the plant science lab agreed to be videotaped for the purposes of this research study. Selected activities from nearly all the labs has been documented in videotape footage. Putting this visual information to meaningful use is challenging and extremely time consuming, and one solution to this problem has been to use selected visuals with descriptive filenames to identify where key footage is located on the tapes. This organizing system has been a useful way to get quick access to the most likely to be used visuals which were accessible to many uses and manipulations once put in digital format.

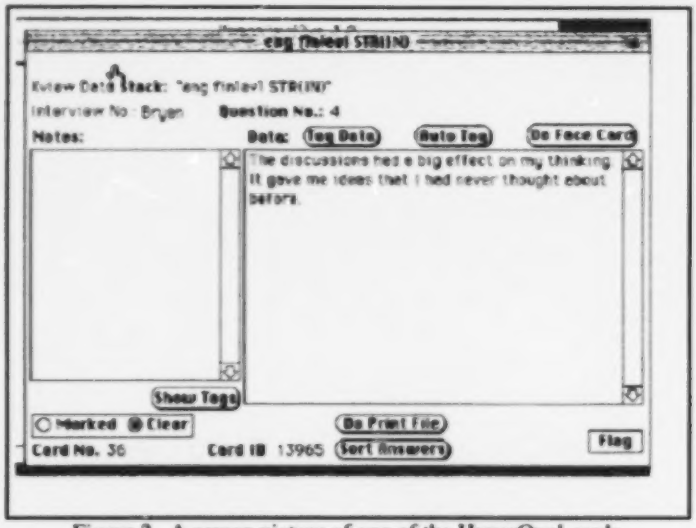

Figure 2. A screen picture of one of the HyperQual cards.

Graphical Interface to Electronic Discussions

The key source for documenting on-line interactions was through in-class discussions which occurred on-line via the *Daedalus Integrated Writing Environment*™ (Daedalus) software. The electronic text files archived from the CMC discussions represent the discourse created by student and teacher interactive writing activities, and was considered raw data until these text files were described, coded, and interpreted. Some descriptive labels have been added to each message in all the transcripts by the researcher such as: an interchange code and number indicating which interchange and what sequence in the interchange from which this excerpt was taken. The student and instructor names were changed on all the transcripts to pseudonyms to protect the identity of participants. Excerpts from interchanges presented in this document are presented in a different font to readily distinguish the electronic transcripts from this research report. Excerpts from the interchange transcripts are presented without editing. Existing spelling and grammatical errors are not typographical errors, but represent how the message appeared in the interchange.

Analysis Strategies

Analysis of these text archives involves several strategies: (1)coding the messages by content, rhetorical strategies and according to affective quality; (2) quantitative measures of participation and interaction were used and displayed to compare individual participation within a given discussion and to compare overall class participation across discussions; (3) an analysis of the pattern of message flow as developed by Levin, Kim, and Riel (1990) was used to graph the pattern of interactions in the on-line interchange.

Coding Data According to Content Description and Affective Quality. The nature of the messages sent was described

in terms of several distinct categories which were then used for comparison and analysis. Several different coding systems were used to interpret and describe the nature of the interactions and content of the electronic transcripts. Each different coding system requires enormous amounts of time to complete the analysis of a single interchange transcript. Three different systems were used to analyze one or more transcripts. There are many other coding systems that could be used beyond the ones mentioned here, and this is not meant to be an exhaustive testing of all possibilities. Different methods of analysis have been used because each illustrates another variation on how electronic texts can be interpreted and each method looks for a different qualitative aspect of the text which the others cannot detect. The issue that emerges from this process becomes not which method of analysis is best, but which method can pull out the qualitative features of greatest relevance to this study and what features does this method overlook.

A rhetorical content coding system used by Butler (1992) was modified from a twelve to ten groups system by combining the last four categories into two as follows: (1)Question; (2) Reply; (3) Consensus Building; (4) Evaluation; (5)Topic Initiation; (6) Assertion; (7) Acknowledgment; (8) Off-Task; (9) Qualification/Definition; and (10) Clarification/Elaboration. This system describes the nature of the content of the interchange, but is limited because it does not help the researcher classify the social-emotional quality of each message.

The Bales Interaction Analyses Scale (Bales, 1950/1976) to provide a coding system which could describe the positive, negative, or neutral quality of social mediations evidenced in the text transcript. In analysis of the interchange transcripts, the Bales system for categorizing interchange transcripts provides fairly adaptable categories for coding the text messages which would account for the social-emotional quality of the message. Figure 3 illustrates how many of the messages conveyed some degree of social psychological information within the textual message.

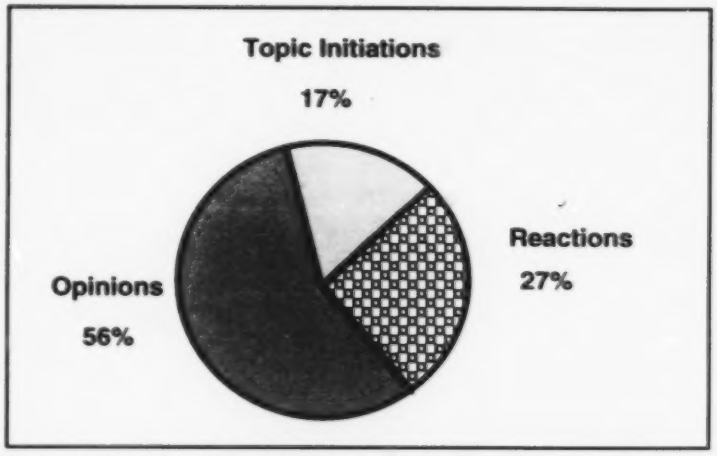

Figure 3. A comparison of the content of student on-line messages based on the Bales Interaction Analysis Scale.

Quantitative Measure of Network Connections. Descriptions of the raw data include averages, percentages, and ratios of interactions on-line. The Daedalus concordance utility program was used to count the number of words per message, words per participant per interchange, number of sentences and number of questions per interchange. Additional numeric data comes from documenting and counting the network connections associated with each interchange. This includes the number of messages sent and received in chronological order. In this class students always logged into Daedalus using their real names; pseudonyms were not used. Transcripts of interchanges were saved in chronological sequence. The level of participation in different interchanges varied depending on the topic, the amount of time students were given to be in a given interchange, and the sequence in which an interchange

occurred.

Three additional quantifiable measures of individual participation include--the *participation ratio*, *participation frequency*, and *integration ratio*. These measures along with the volume ratio provide quantitative information about participant interaction and participation. The participation ratio represents the number of messages sent divided by the total number of messages. The volume ratio is similar to the participation ratio, but instead divides the number of words sent by the total number of words in the interchange. This quantitative comparison gives an indication of the relative length of a person's message. When compared with the participation ratio the volume ratio shows not just how often, but also what percent of the discourse volume is generated by a given participant.

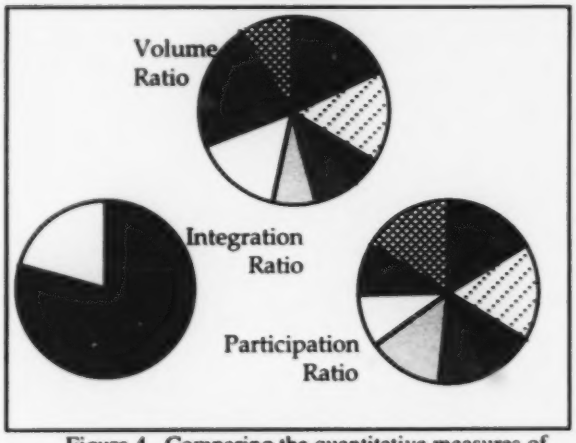

Figure 4. Comparing the quantitative measures of participation.

Message Act Analysis. The "message act analysis" developed by Levin, Kim, and Riel (1990) is based on the system for classifying instructional speech acts developed by Mehan (1950/1978) to document a common classroom interaction pattern called "IRE sequences" which involves--Initiation by teacher; Reply by student; Evaluation by teacher. When they applied Mehan's analysis system to "message acts" in electronic instructional teacher-student interactions, Levin et al. (1990, p. 206) found that "...There are substantial differences between face-to-face instruction and instruction conducted using electronic networks. However, there are also important similarities." The key difference between globally distributed electronic group interactions and face-to-face interactions is related to the nature of time. Using electronic networks to link people who are geographically distributed allows the discussion to become time-independent. However, stretching interactions over this "non-real time medium" (Levin et al., 1990, p. 210) changes the course of interactions in ways not fully understood. While the interactions are stretched out over new, unpredictable time bands, the participants are partly compensated by the multiple threads of discussions occurring simultaneously.

This study looked at in-class use of electronic discussions and avoids some of the timing problems associated with distributed electronic groups because the interchange must end at the end of the class period. The message act analysis is useful for describing the pattern of teacher-student interactions in the electronic community. Figure 5 shows how this method of analysis was used to interpret the capstone transcripts of student-peer and student-teacher interactions in the freshman writing class. Levin et al. (1990) indicate that the typical IRE sequence is spread out in the electronic communication environment--particularly when participants in distributed geographic locations are linked via electronic mail. Figure 5 illustrates the IRE sequence as it occurred in one of the capstone interchange discussions. Even here where all communications occurred within a class period, responses are spread out and are sent at different time intervals. Students continued to send their responses to the teacher's initial question while other

subsequent topics for discussion were initiated.

As the illustration of the electronic message flow in Figure 5 indicates, student responses to teacher initiations dominate the discourse. The message act analysis developed and described by Levin, Kim, and Riel (1990) is a useful model for describing the sequence of interactions which can then be diagrammed to visualize the IRE sequence, but this kind of analysis did not describe the emotional quality of the messages as part of its coding system. Since this study focused on describing how students interacted with each other on-line, the Bales analysis tool was used to track the social emotional quality of the messages.

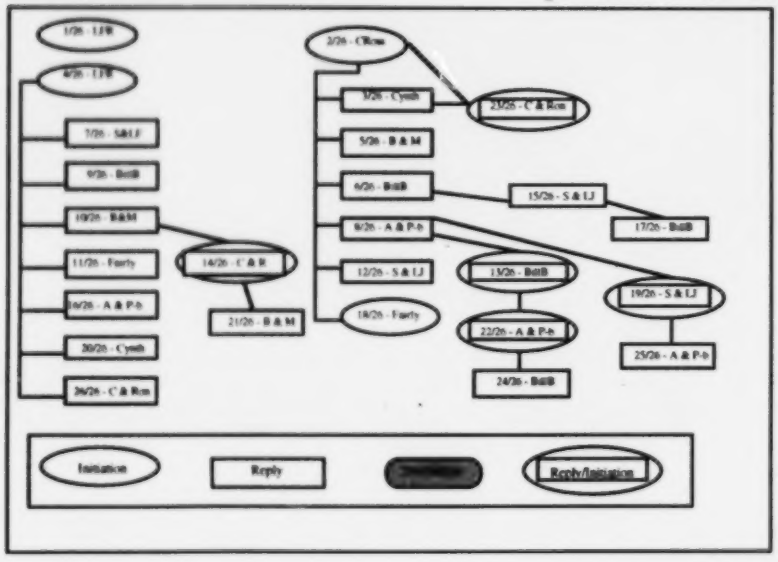

Figure 5. Message flow analysis of Plant Science Lab Capstone Interchange.

Graphics to Facilitate Interpretations & Comparisons

The Daedalus Interchange program was used for the interactive writing exercises in both the freshman writing class and the plant science lab, so students interacted with the computer via the same human-computer interface. However, the instructional goals and other in-class activities in these two classes were differed in many ways. One of the challenges with this dual setting study was to find meaningful ways to compare the interchanges between these classes.

One of the most interesting comparisons between these two classes was shown in the scatter plot which compared the percentage of questions created in two interchanges. The plant science lab tended to have more questions in each interchange, and in fact, one of the goals as expressed by the developer of this course was that students be stimulated to ask questions and learn what kind of questioning process is involved in the study of plants.

The computer-based discussion produced in lab nine was exceptionally interactive. The high level of interactivity in this discussion is visually represented in the message flow analysis of this lab which is shown in Figure 6. Students initiated the majority of questions in this discussion and students responded and followed up on each others' questions and comments more so than in other interchanges. The prior activities in this class prepared students for an active discussion which built upon a face-to-face interactions directed by the teacher during the hands-on manipulation and observation of live plants.

This interchange is a good example of how the interactive writing activities can be used to summarize and move further into topics that are discussed and/or demonstrated in other parts of the class. In no other aspect of the lab activities were all students simultaneously active participants

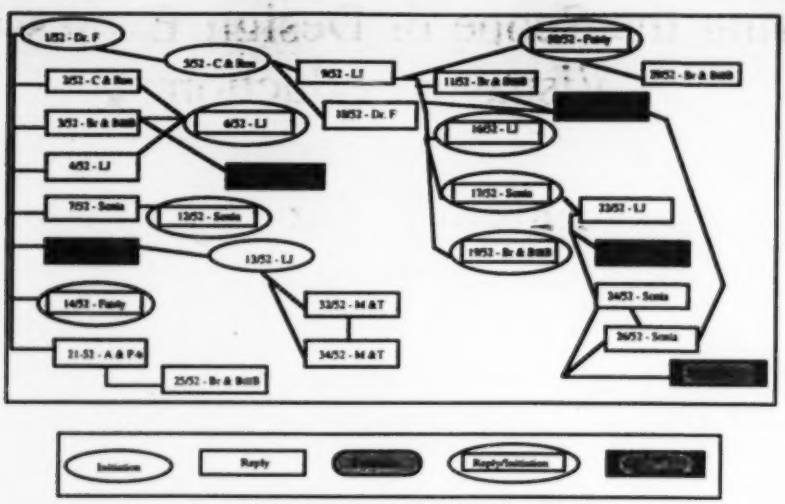

Figure 6. Message flow analysis of lab 9.

generating responses and questions. For many of the students this was considered to be one of the best labs, and simultaneously, this interchange was rated as being one of the best interactive discussions for this class by both the teacher and the students. Figure 6 illustrates the pattern of interactions that occurred in this successful on-line discussion. The message flow analysis displayed graphically in Figure 6, provides a visual representation of participation and interaction and additional information which complements what is learned from close analysis of the interactive discourse.

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